

REMARKS

In response to the July 31, 2006 Office Action, Applicants respond to the Examiner's detailed action with the following remarks organized according to the Examiner's communication, and respectfully requests reconsideration.

Claim Rejections – 35 USC §102 / 35 USC §103

In response to the Examiner's rejection of Claims 9 – 15 under 35 U.S.C. § 102(b) and § 103(a) as being anticipated and/or rendered obvious by U.S. 5,323,022 (Glass), Applicant respectfully disagrees. "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). Moreover, To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974).

Glass teaches a ohmic contact structure between a metal (platinum) layer and **p-type silicon carbide**, specifically, Glass states "the invention is **most useful in making an ohmic contact to p-type silicon carbide**, as the doping technique...if used to implant p-type dopants into n-type SiC would produce a p-n junction rather than an ohmic contact to p-type SiC," (column 4, lines 8 – 15, emphasis added). Glass does not teach an ohmic contact formed by annealing a n-type semiconductor device at an annealing temperature less than approximately 900 Celsius for an annealing duration of greater than approximately two hours. Amended Independent Claim 9 includes the limitations of "a wide band-gap layer of n-type semiconductor material," and "an ohmic contact formed

by annealing said semiconductor device at an annealing temperature less than approximately 900 Celsius for an annealing duration of greater than approximately two hours.”

The claims are distinctive from Glass because the language “n-type semiconductor material” indicates that the wide bandgap material used in the invention preferably comprises n-type silicon carbide, while Glass teaches only p-type silicon carbide, and specifically teaches away from n-type silicon carbide by stating, “it appears most likely that the doped layer **must include a sufficient concentration of p-type dopant** to reduce the width of the depletion region sufficiently at the interface between the metal contact and the semiconductor material,” (column 4, lines 32 – 37). The claims are directed to an invention that has the advantage of comprising an n-type semiconductor material upon which an ohmic contact can be disposed, whereas Glass explicitly requires a p-type semiconductor material. Applicant respectfully submits that Claim 9 and all claims that depend therefrom are therefore in condition for allowance.

Moreover, Glass does not teach nor suggest the annealing step necessary for the formation of the ohmic contact. The Examiner has posited that “the method of making the contact region by annealing the semiconductor device at an annealing temperature of approximately 900 Celsius for an annealing temperature of greater than approximately two hours **is an intermediate process step that does not affect the structure of the final device.**” This statement is technically inaccurate. The annealing step is necessary in the present invention to alter the metallurgy of the metal layer (*e.g.*, nickel) to be ohmic.

Applicant respectfully directs the Examiner's attention to Figure 4 of the application (attached as Appendix "Exhibit A"). Figure 4 shows plots of current versus voltage between two metal contacts disposed on a layer of wide band-gap semiconductor material for various durations of annealing time. Specifically, Figure 4 demonstrates the impact of the annealing time and temperature on a nickel layer. Figure 4 shows that nickel, as deposited, is **not ohmic** (See reference curve "C0"). When a device containing a nickel layer is annealed at 800° Celsius for four hours, the contact regions become substantially completely ohmic (See reference curve "C4"). The ohmic nature of the contact regions is shown by the substantially linear nature of the voltage-versus-current plot of reference curve C4. As a result, Figure 4 shows that **the annealing step is necessary** to create an ohmic contact between a nickel layer and a n-type silicon carbide layer.

If one skilled in the art followed the disclosure of Glass, the device would fail. Specifically, Glass teaches an ohmic contact produced by depositing platinum and implanting aluminum ions at 600° Celsius (column, 8, lines 36 – 40). Platinum, unlike nickel, is **already substantially ohmic when deposited**. This is shown by Glass, Figure 5 (See Appendix "Exhibit B"). As a result, **the annealing step is unnecessary in Glass to create an ohmic contact**. However, as shown in Figure 4 of the present application, a nickel layer was annealed at 600° Celsius for two hours, and the results indicate that the 600° Celsius, two hour annealing process (as taught by Glass) did little if anything to convert contact regions from their pre-annealing rectifying nature toward an ohmic characteristics (See reference curve "C0"). Therefore, the method of making the contact region by annealing the semiconductor device at an annealing temperature of

approximately 900 Celsius for an annealing temperature of greater than approximately two hours **is a necessary process step that substantially affects the structure of the final device.** Applicant respectfully submits that Claim 9 and all claims that depend therefrom are therefore in condition for allowance.

Applicants appreciate the opportunity to call the Examiner but believe that the forgoing remarks fully address the issues raised by the Examiner. On the other hand, the Examiner is invited to call the undersigned attorney if he has any matters to address that will facilitate allowance of the application. Applicants respectfully request favorable consideration and that a timely Notice of Allowance be issued in this case.

In the event that Applicants have overlooked the need for an extension of time, additional extension of time, payment of fee, or additional payment of fee, Applicants hereby conditionally petition therefore and authorize that any charges be made to Deposit Account No.: 50-3010.

Respectfully submitted,
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